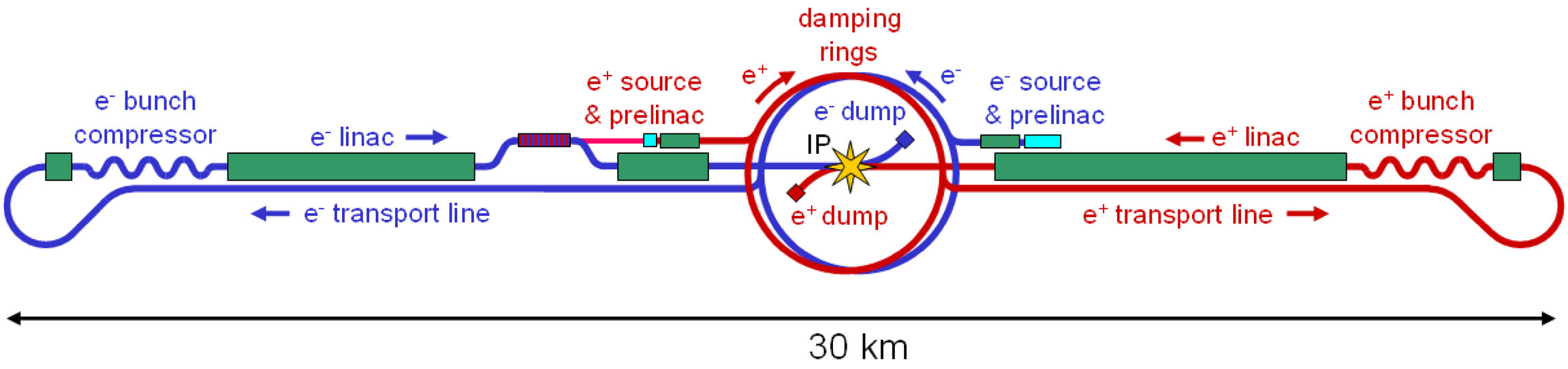
The ILC Damping Rings

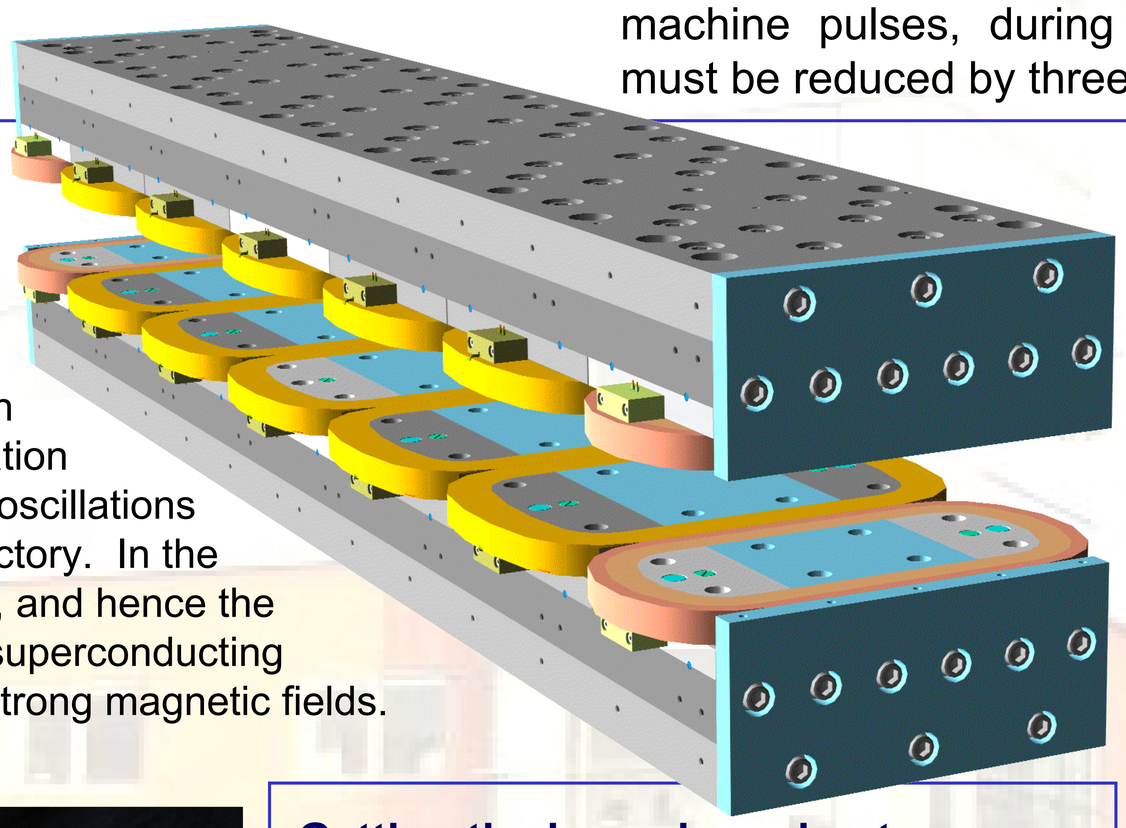


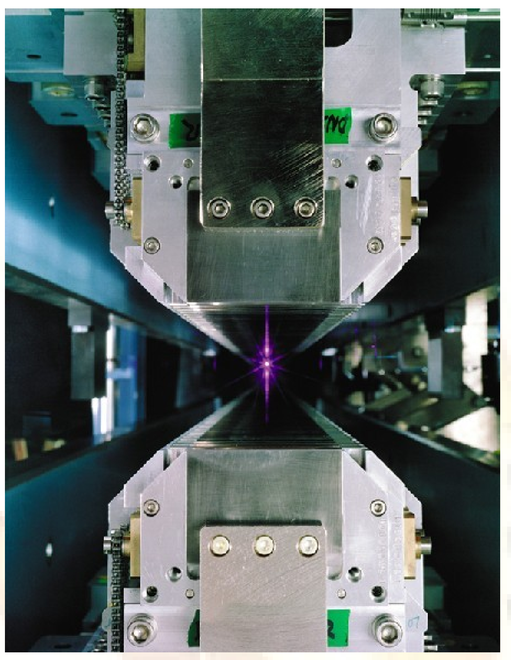
The role of the damping rings in a linear collider is to improve the quality and stability of the high intensity beams from the sources, so that collisions at the interaction point result in high luminosity. For the ILC, the beams need to be smaller and more stable than any achieved in accelerators constructed and operated so far.

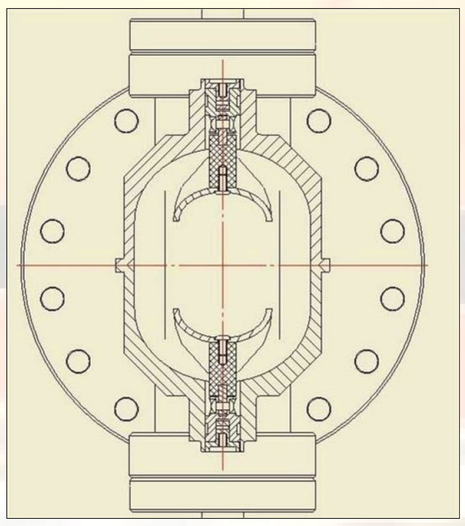
In the present configuration, the damping rings consist of a pair of synchrotron storage rings of circumference about 6.5 km, beam energy 5 GeV, and operating with 400 mA of beam current in 3000 bunches. The beam is stored for 200 ms between machine pulses, during which time the beam size must be reduced by three orders of magnitude.

Improving beam quality

Beam sizes in the damping rings are reduced using the effects of synchrotron radiation. As relativistic particles move through magnets in an accelerator (*far right*), they emit radiation that acts like a frictional force on the oscillations of the particles around the ideal trajectory. In the damping rings, synchrotron radiation, and hence the damping rates, are enhanced using superconducting "wigglers" (*right*) that generate very strong magnetic fields.

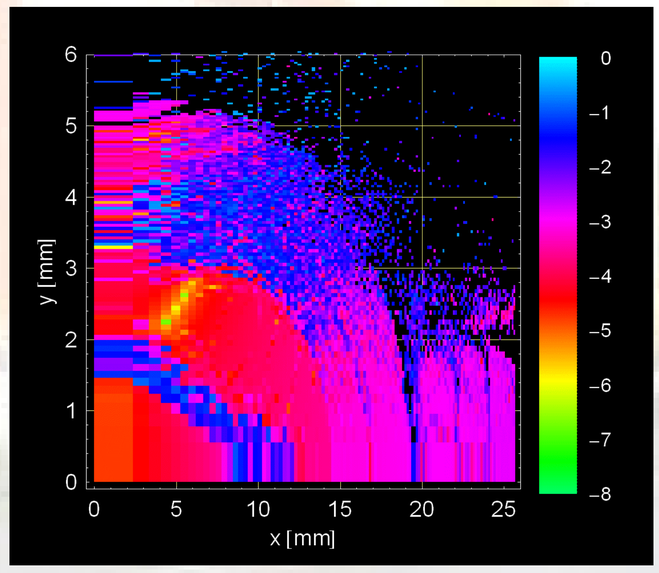


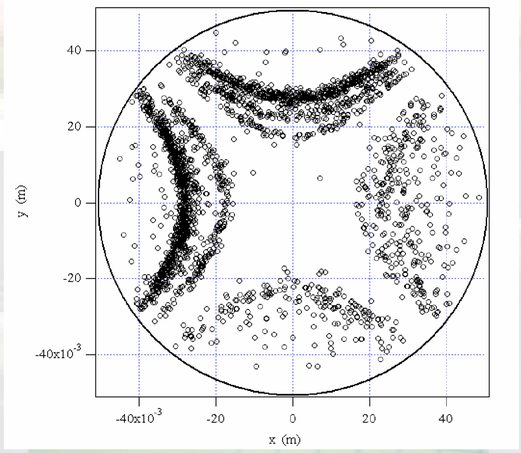




Getting the beam in and out

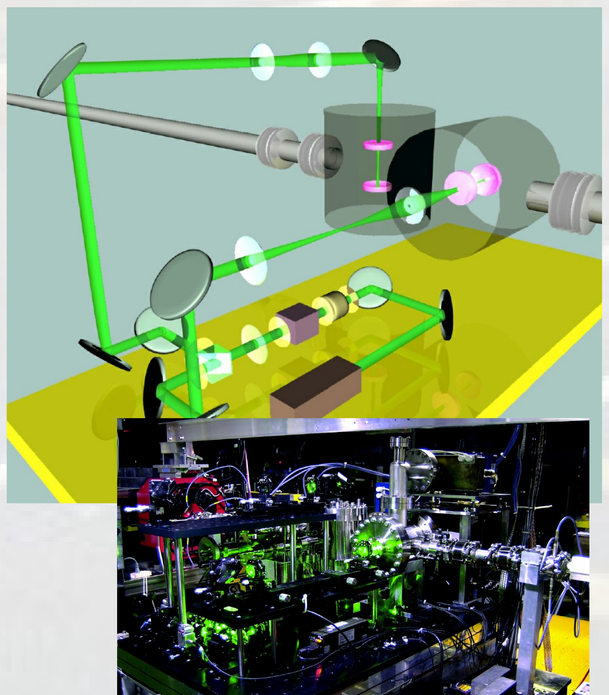
Bunches are injected and extracted from the ring individually, using fields between electrodes (*far left*) driven by ultra-fast, high power "pulsers" (*left*). These pulsers must switch voltages of around 10 kV on and off in a few nanoseconds. Dynamical effects can limit the size of the beam that can be injected without loss into the damping rings; the stability of particle orbits of different amplitudes can be analysed using frequency map analysis (*right*).





Keeping the beam stable

Particles in an accelerator can interact with each other and with their environment in many different ways. Some of the interactions can make the beam unstable: the beam size blows up, or the beam position jitters. Research and development are needed to make sure that effects such as electron cloud (*left*) in the positron damping ring do not limit the performance of the damping rings.



Measuring micron beams

The goal of the damping rings is to produce stable beams with dimensions of microns. To measure these beam sizes with sufficient accuracy and precision, new kinds of diagnostics are needed, such as laser wires (*left*). In a laser wire, a beam of photons is scanned across the electron beam. The Compton-scattered photons are counted to determine the density of the electron beam as a function of position.

international linear collider

Science & Technology Facilities Council

The Cockcroft Institute
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